AP020 FET PROBE
Manual Performance Check

Corporate Headquarters
700 Chestnut Ridge Road
Chestnut Ridge, NY 10977-6499
Tel: (845) 578-6020
Fax: (845) 578-5985
http://www.lecroy.com

AP020-L2 ECO 1002 August 2001

1.- INTRODUCTION 3

2.- SUMMARY OF TESTS 3

3.- TEST EQUIPMENT REQUIRED 3

4.- PROBE IDENTIFICATION AND REPORT FORM ..... ERROR! BOOKMARK NOT DEFINED.

5. PROBE IMPEDANCE 5

5.1.- SPECIFICATION 5
5.2. - PROCEDURE 5
5.3.- PANEL SETUP 5
5.4.- SCOPE MANUAL SETUP 5
5.5.- MEASUREMENT 5

6.- PROBE ATTENUATION 6

6.1.- SPECIFICATION 6
6.2.- PROCEDURE 6
6.3.- SCOPE PANEL SETUP 6
6.4.- SCOPE MANUAL SETUP 6
6.4.- MEASUREMENT 6

7. - VERIFICATION OF PROBE OFFSET GENERATION 6

7.1.- PERFORMANCE 6
7.2.- PROCEDURE 6
7.3.- SCOPE PANEL SETUP 7
7.4.- SCOPE MANUAL SETUP 7
7.4.- MEASUREMENT 7

8.- PULSE RESPONSE VERIFICATION 7

8.1.- PERFORMANCE 7
8.2.- PROCEDURE 7
8.3.- SCOPE PANEL SETUP 7
8.4.- SCOPE MANUAL SETUP 7
8.5.- MEASUREMENT 8

9.- AC AND DC COUPLING 9

9.1.- PERFORMANCE 9
9.2.- PROCEDURE 9
9.3.- SETUP 9
9.4.- MEASUREMENT 9

10.- BANDWIDTH AND FLATNESS 9

10.1.- SPECIFICATION + PERFORMANCE 9
10.2.- PROCEDURE 10
10.3.- SCOPE PANEL SETUP 10
10.4.- SCOPE MANUAL SETUP 10
10.5.- MEASUREMENT 10

11. - FINAL STATUS 10

REPORT FORM 11

1.- INTRODUCTION

This document gives a detailed step by step procedure to check if an AP020 FET probe functions correctly and if it satisfies its specifications. If executed with calibrated and traceable equipment it constitutes a demonstration of traceable calibration of the AP020.

If the behavior of the probe under test (PUT) diverges from what is shown in the procedure or demanded by the test limits the probe should be returned to LeCroy for repair. Please include the partial test report and any additional information (screen dumps) that help characterize the problem. This procedure is only concerned with verification and will not treat the repair issue.

Answers to questions concerning installation, calibration, and use of LeCroy equipment are available from the Customer Service Department, 700 Chestnut Ridge Road, Chestnut Ridge, NY 10977-6499, 1-800-553-2769 or 845-578-6020.

To allow quicker and more reliable execution, this procedure may be executed with the help of panel setups stored on a floppy disk (AP020FLOPPY-L3).

2.- SUMMARY OF TESTS

The following aspects of probe performance are checked:

- Probe Impedance at DC - traceable specification
- Probe Attenuation at DC - traceable specification
- Verification of Probe Offset Generation
- Pulse Response Verification
- AC and DC Coupling Functionality Check
- Bandwidth - traceable Specification
- Flatness of frequency response

3.- TEST EQUIPMENT REQUIRED

This procedure uses a traceable RF signal generator (sine wave), a traceable digital multimeter, a traceable LeCroy 1GHz oscilloscope, and a DC precision power supply.

Instruments	Specifications	Recommended
Digital MultiMeter (voltage & resistance)	Accuracy: < 0.2%	Keithley 199, 2001 or equivalent (equipped for BNC output)
Digital Oscilloscope	LeCroy: with ProBus Bandwidth: ≥ 1GHz	9370,9374,9384, LC534 or equivalent
DC precision Power Supply	Amplitude: 10 V DC Accuracy: < 0.1 %	Tektronix PS5004 or Hewlett Packard 6633 or equivalent (equipped for BNC output)
RF Signal Generator (sine wave)	Frequency: 0.5 MHz to 1 GHz Power: 13 or 19 dBm	HP 8648B or equivalent (equipped for BNC output)

Additional equipment required includes:

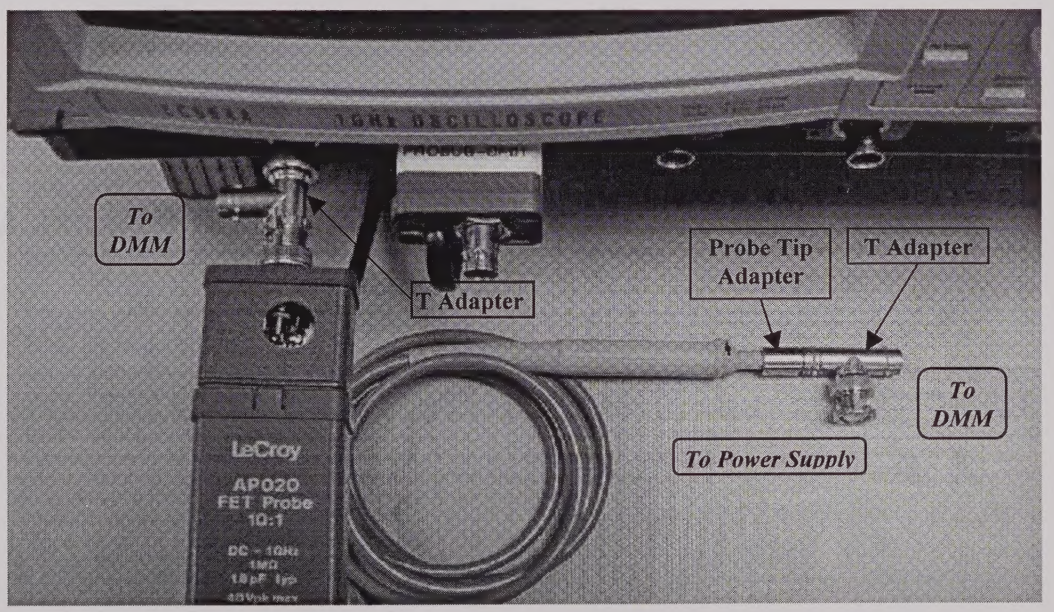
Item	Description	Recommended
2 - BNC Cables	BNC, 50 Ω, length 50 cm (2 ns) length ~ 1m	LeCroy 480232001 LeCroy 480020101
BNC Feed Through Termination	50 ± 1 Ω Feed Through Termination 1 GHz	Suhner 6701.01.B
2- BNC T adapter	BNC, 50 Ω, T adapter	Suhner 43 BNC-50-0-1 LeCroy 402222002
20dB Attenuator	BNC, 50 Ω, 4 GHz, 20dB Attenuator	Suhner 6820.01.A LeCroy 402200402
Probe Tip to BNC Adapter	Probe Tip input BNC Male output	Provided in AP020 kit
Calibration Fixture	ProBus Extension Cable	LeCroy, PROBUS-CF01

4.- PROBE IDENTIFICATION and REPORT FORM

The last pages of this document contain a report form to be used to record the results of the tests done. The report form should be filled out by the technician doing the test. Before testing is started it is recommended to fill in the basic identification information. The nominal recommended calibration interval is 1 year.

The Probe identification can be found as follows:

- Connect the PUT to the oscilloscope as shown. BE CAREFUL to respect the connector orientation for the ProBus Cable.



- Go to the Main menu (by pressing return). Push the third and then simultaneously the fourth menu button. Release both buttons and push the fifth button to get into the INTERNAL menu. Then go to the Maintenance menu and then the Probe ADC Data menu. The contents of the I2C EEPROM memory will be displayed below the Channel B title in a format similar to what is shown here

01 08 00 41 50 30 32 30 04 06 95 28 00 13 11 06 41 20 00 00 …

The four underlined bytes are the serial number of the PUT. They should be entered onto the report form.

- The type, serial numbers, calibration dates and calibration due dates should be entered for all of the indicated equipment. A traceable calibration should not be performed if the calibrations are no longer up to date. The final source of the traceability of this calibration can be deduced as a function of the traceability of the equipment used.

5. Probe Impedance

5.1.- Specification

The probe Impedance is 1MΩ ± 2%

5.2. - Procedure

The probe tip's impedance is measured with the DMM.

5.3.- Panel Setup

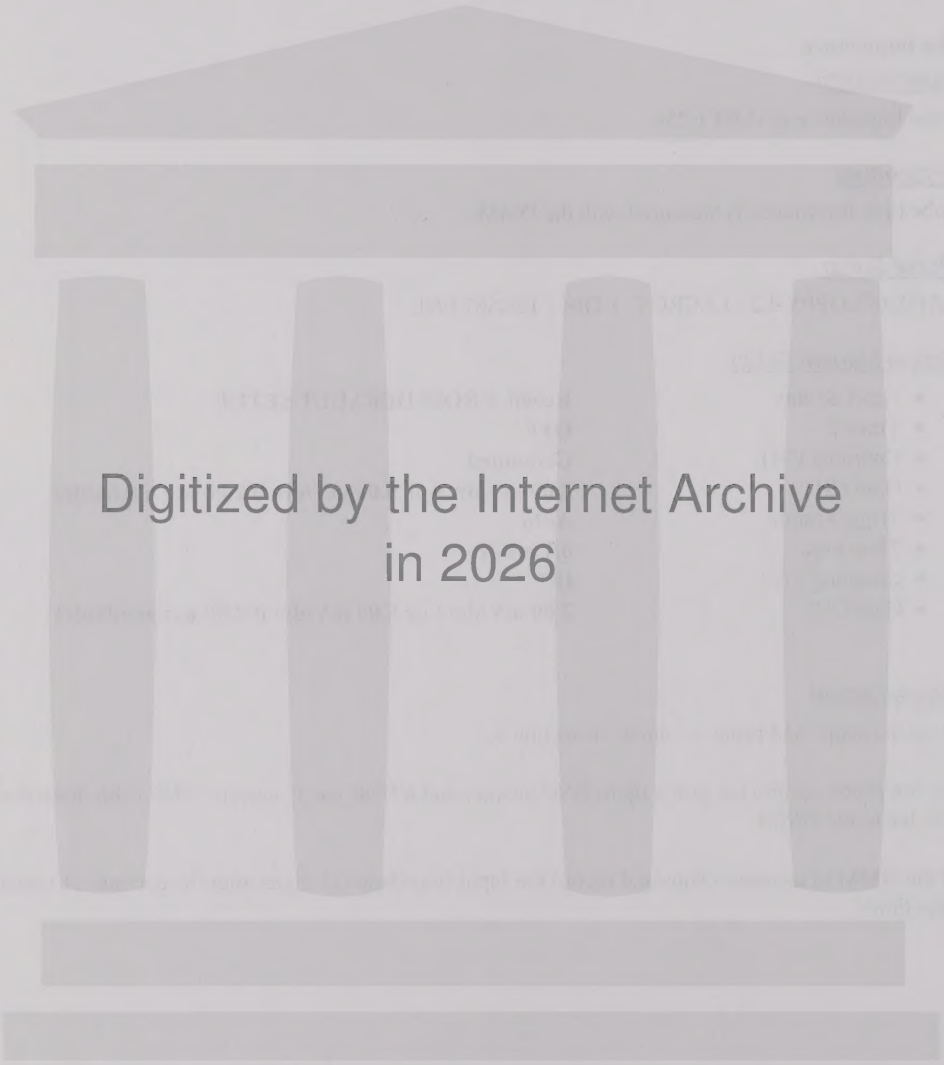
Recall AP020FLOPPY-L3 / LECROY_1.DIR / Test567.PNL

5.4.- Scope Manual Setup

- Panel Setups : **Recall FROM DEFAULT SETUP**
- Trace 2 : **OFF**
- Coupling CH1 : **Grounded**
- Gain CH1 : **2.00 mV/div (or 5.00 mV/div if 2.00 not available)**
- Trigger mode : **Auto**
- Time base : **0.1 ms/div.**
- Coupling CH2 : **DC**
- Gain CH2 : **2.00 mV/div (or 5.00 mV/div if 2.00 not available)**

5.5.- Measurement

- Set up the scope and probe as shown in section 4.
- Plug the probe tip into the probe tip to BNC adapter and a BNC tee. Connect a BNC cable from the BNC tee to the DMM.
- Set the DMM to measure Ohms and record the Input Impedance (3 digits after the decimal). Compare it to the limits.



Digitized by the Internet Archive
in 2026

https://archive.org/details/manualsplus_12535

6.- Probe Attenuation

6.1.- Specification

The probe attenuation is 10:1 ± 1 %

6.2.- Procedure

The probe attenuation at DC is checked by measuring a ± two volt (± 2 V) level, both with a precision digital multimeter before and after the probe.

6.3.- Scope Panel Setup

Recall AP020FLOPPY-L3 / LECROY_1.DIR / Test567.PNL

6.4.- Scope Manual Setup

- Panel Setups : **Recall FROM DEFAULT SETUP**
- Trace 2 : **OFF**
- Coupling CH1 : **Grounded**
- Gain CH1 : **2.00 mV/div (or 5.00 mV/div if 2.00 not available)**
- Trigger mode : **Auto**
- Time base : **0.1 ms/div.**
- Coupling CH2 : **DC**
- Gain CH2 : **2.00 mV/div (or 5.00 mV/div if 2.00 not available)**
- Offset CH2 : **0.00 V**

6.4.- Measurement

- Set up the scope and probe as shown in section 4.
- Adjust the DC precision Power Supply to **+ 2 V**
- Plug the AP020 probe tip, using the probe tip to BNC adapter and a T BNC Adapter, to the Power Supply
- Measure the voltage at the T BNC Adapter in front of the AP020 and enter it in the report with 3 significant digits.
- Measure the voltage at the T BNC Adapter after the AP020 and enter it in the report with 3 significant digits.
- Repeat the above 2 measurements for the DC Precision Power Supply adjusted to : **–2 V** (or with the polarity or BNC banana adapter reversed).
- Calculate the differences and the ratio of these differences and compare it to the limits.

7. - Verification of Probe Offset Generation

7.1.- Performance

The probe DC Offset Range is ± **20 V** and it ought to be accurate within the limits allowed by the internal offset DAC.

7.2.- Procedure

The probe Offset Generation is checked at three points (–20V, 0 V, +20 V) by measuring a DC level with the Digital MultiMeter, adjusting the AP020 offset to the nominal level needed to cancel the applied signal and measuring and checking the AP020 output level with a Digital MultiMeter.

7.3.- Scope Panel Setup

Recall AP020FLOPPY-L3 / LECROY_1.DIR / Test567.PNL

7.4.- Scope Manual Setup

- Panel Setups : **Recall FROM DEFAULT SETUP**
- Trace 2 : **OFF**
- Coupling CH1 : **Grounded**
- Gain CH1 : **2.00 mV/div (or 5.00 mV/div if 2.00 not available)**
- Trigger mode : **Auto**
- Time base : **0.1 ms/div.**
- Coupling CH2 : **DC**
- Gain CH2 : **2.00 mV/div.**

7.4.- Measurement

- Set up the scope and probe as shown in section 4.
- Push **Show Status** and select the **Acquisition** Status. Push the button to Select Channel **2**
- Plug the AP020 probe tip, using the probe tip to BNC adapter and a T BNC Adapter, to the Power Supply
- Adjust the DC precision Power Supply to + 20 V
- Measure the voltage at the T BNC Adapter in front of the AP020 and enter it in the report with a precision of 1 mv. If it is above 20 V reduce the voltage at the Power Supply to be within the allowed range.
- Adjust the offset of channel 2 to the negative of the value measured just above.
- Measure the voltage at the T BNC Adapter after the AP020 and enter it in the report with a precision of 1 mv. Compare it to the limits.
- Repeat the above steps for the DC Precision Power Supply adjusted to : **~0 V** and then **–20 V**

8.- PULSE RESPONSE VERIFICATION

8.1.- Performance

The probe's response to a step function needs to be flat to within ± 1 %.

8.2.- Procedure

The HF measured CAL signal, averaged and zoomed, must be within ± 1 % of its final DC level

8.3.- Scope Panel Setup

- Recall AP020FLOPPY-L3 / LECROY_1.DIR / Test8.PNL
- Turn on Cursors/Measure Menu

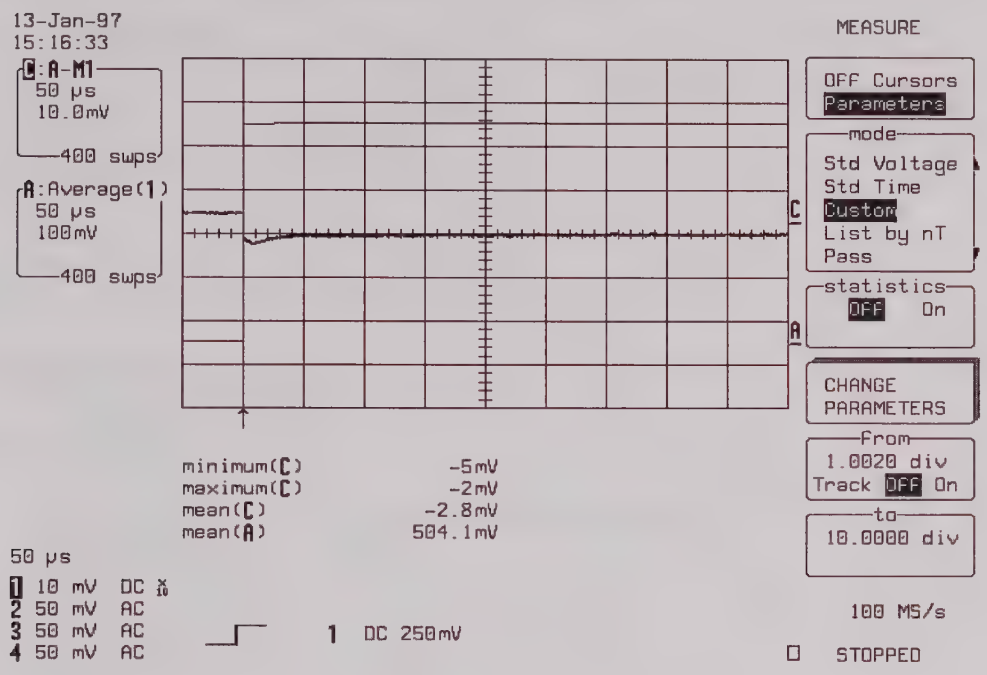
8.4.- Scope Manual Setup

- Panel Setups : **Recall FROM DEFAULT SETUP**
- Trace 1 and 2 : **OFF**
- Coupling CH1 : **50Ω**
- Gain CH1 : **10 mV/div**

- Probe Attenuation CH1 : **x10**
- CH1 Offset : **–250 mV**
- Trigger on : **Channel 1**
- Trigger coupling : **DC**
- Trigger level : **250 mV**
- Time base : **50 µs/div and 10% Pre-trigger Delay**
- Record up to : **50k** samples (at least)
- CAL signal Amplitude : **1 V** into 1MΩ
- CAL signal Frequency : **500 Hz**
- Redefine A : **use Math Yes, Average (1) Summed for 400 sweeps**
  use max points 1000000
- Trace A : **ON**
- Trigger mode : **AUTO**
- Measure : **PARAMETERS, Std Voltage**
  from 1.0020 to 10.0000 div
- Redefine C : **A – M1**
- Trace C : **ON**
- Measure : **PARAMETERS, CUSTOM Statistics Off**
  CHANGE PARAMETERS
  DELETE ALL PARAMETERS
  line 1 minimum(C)
  line 2 maximum(C)
  line 3 mean(C)
  line 4 mean(A)

8.5.- Measurement

- Connect the CAL signal to channel 1 by a 2 ns BNC cable and the 20dB attenuator. (Remove the probe completely if it is still connected).
- Set Trigger Mode to **NORMAL, Clear Sweeps** and when A:Average(1) has 400 sweeps **store A to M1**. You may want to turn off parameter measurements to speed up the process.
- Plug the AP020 into channel 1.
- Plug the AP020 Probe tip into the probe tip to BNC adapter and via the 50Ω feed through termination into the CAL signal.
- Press **CLEAR SWEEPS**. When A:Average(1) has 400 sweeps **STOP**
- Using the vertical ZOOM control adjust the trace C to give 10 mv/div and the vertical position to mid-screen at its right hand edge.
- Go back to the MEASURE menu and record the four parameter values with 1 mv precision
- Calculate the maximum deviation as the largest of maximum(C) - mean (C)
  or mean(C) - minimum(C)
- Calculate the relative value by dividing the maximum deviation by mean(A) and compare it to the limit.



9.- AC AND DC COUPLING

9.1.- Performance

The AP020 coupling are AC and DC.

9.2.- Procedure

Check if the probe switches from DC to AC on command from the scope

9.3.- Setup

- Panel Setups : **Recall FROM DEFAULT SETUP**
- Trace 2 : **OFF**
- Cursors/Measure : **Parameters** **Std Voltage**

9.4.- Measurement

- Plug the AP020 into channel 1.
- Plug the AP020 Probe tip into the probe tip to BNC adapter and via the 50Ω feed through termination into the CAL signal.
- Press AUTOSETUP
- Record (mv precision) and check the mean(1) and ampl(1) parameters under DC coupling
- Set Coupling : **AC 1MΩ**
- Press AUTOSETUP
- Record and check the mean(1) and ampl(1) parameters under AC coupling

10.- BANDWIDTH AND FLATNESS

10.1.- Specification + Performance

Performance limits on Attenuation (relative to 1 MHz)

@ 30 MHz : within ± 0.3 dB

@ 250 MHz : within ± 0.6 dB
@ 750 MHz : within ± 0.5 dB
or in the range +0.5,– 1.6 dB for probes whose Serial Number is below 9703

Specification limit on Attenuation (relative to 1 MHz)
@ 1 GHz : less than 3.0 dB

10.2.- Procedure

The frequency dependent attenuation is compared to that of a passive attenuator.

10.3.- Scope Panel Setup

AP020FLOPPY-L3 / LECROY_1.DIR / Test10.PNL

10.4.- Scope Manual Setup

- Panel Setups : **Recall FROM DEFAULT SETUP**
- Set DSO Channel 2 : **Off**
- Coupling CH1 : **50Ω**
- Gain CH1 : **100.0 mV/div**
- Probe Attenuation CH1 : **x10**
- Trigger mode : **Auto**
- Time base : **10 µs/div.**
- Measure : **PARAMETERS, Std VOLTAGE Statistics On**

10.5.- Measurement

- Connect the 2ns BNC cable to the RF generator and then through the 20dB attenuator into Channel 1.
- Set the Generator Frequency : **1.1 MHz**
- Signal Amplitude : **19.0 dBm (or the maximum available if less than 19 dBm)**
- Press **Clear Sweeps** and measure and record the average value of sdev(1) (three significant digits) for at least 100 sweeps
- Repeat the above measurement for 30.1 MHz, 250.1 MHz, 750.1 MHz, and 1000.1 MHz
- Plug the AP020 into Channel 1 and the probe tip through a probe tip to BNC adapter and a 50 Ω feed through terminator directly to the RF generator.
- Set the Coupling to DC 1MΩ
- Repeat the 5 frequency dependent sdev measurements and record the values.
- Calculate the ratio $r = sdev_{AP020} / sdev_{20DB}$ for each frequency
- Calculate the ratios $r_{30.1}/r_{1.1}$, $r_{250.1}/r_{1.1}$, $r_{750.1}/r_{1.1}$, and $r_{1000.1}/r_{1.1}$ and test each value against the limits shown.

11. - Final Status

- Complete the report giving temperature, humidity, final status, etc.
- If the final status is OK affix the appropriate label on the probe.

AP020 Serial # _____ Inspection Date:_____ Next Due:_____

Other Identification: _____

Calibration Procedure: AP020-L2 ECO 1002 August 2001

Reference DMM Type: _____ S/N: _____ Traceable to:_____

Cal. Date:_____ Cal. Due:_____

Reference Scope Type: _____ S/N: _____ Traceable to:_____

Soft Version:_____

Cal. Date:_____ Cal. Due:_____

Reference Power Supply Type: _____ S/N: _____ Traceable to:_____

Cal. Date:_____ Cal. Due:_____

Reference Generator Type: _____ S/N: _____ Traceable to:_____

Cal. Date:_____ Cal. Due:_____

Test Results:

Probe Impedance : _____ [MΩ] Max: 1.02 Min: 0.98

Probe Attenuation:

Nominal Voltage	DMM Reading [V] Before AP020	DMM Reading [V] After AP020
+2.00V		
–2.00V		
Differences		

Ratio (Before/After) _____ Max: 10.10 Min: 9.90

Probe Offset Verification:

Nominal Voltage	DMM Reading [V] Before AP020	DMM Reading [V] After AP020	Limit on $\lvert V_{after} \rvert$
+20.00V			20 mV
+0.00 V			1 mV
–20.00V			20 mV

Pulse Response Verification:

minimum(C) _____ mV
maximum(C) _____
mean(C) _____ mean(A) _____ mV

maximum deviation from mean _____ mV
Relative maximum deviation from mean _____% Max: 1%

AC and DC Coupling:

Coupling	Parameter	Value [mV]	Maximum [mV]	Minimum [mV]
DC	mean(1)		275	225
	ampl(1)		475	525
AC	mean(1)		25	–25
	ampl(1)		475	525

Bandwidth and Flatness:

Frequency MHz	$sdev_{20dB}$	$sdev_{AP020}$	Ratio AP020/20dB	Ratio to 1.1 MHz	Lower limit	Upper Limit
1.1				---	---	---
30.1					0.966	1.035
250.1					0.933	1.072
750.1					0.944	1.059 or 1.202 *
1000.1					0.710	--

* This second limit is to be used if the first four digits of the Probe's Serial Number are less than 9703.

Status Received: _____ Returned: _____

Temperature: _____ Humidity: _____ Technician: _____

Approved by:_____ Inspection Report No. : _____

MP MASTER
MA33671